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Josephson superjunction: an SIS junction with a correlated insulator[1] DAVID STROUD, CHRIS PORTER, Ohio State University, KWANGMOO KIM, Korea Institute of Advanced Study —
We consider the properties of an SIS Josephson junction, in which the insulating region is itself a superconductor, but below its superconducting-insulating transition. The junction could, for example, be made of a superconducting film, in which the central region is much thinner than the two regions on either side. To treat quantum fluctuations in both the insulating and the superconducting region, we model the insulator as itself an SIS Josephson array below its S/I transition and the superconductor as an array above that transition. We calculate the coupling energy of the junction as a function of insulator thickness using two methods. The first is a mean-field approach, generalized to allow for spatial variation of the order parameter. The second approach is to use quantum Monte Carlo simulation, which we use to calculate the phase stiffness as a function of insulator thickness. In both cases, the properties of the junction can be tuned by varying the thickness of the insulating region, and the properties of both superconducting and insulating materials.

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